

Aviation and Aircraft Overview

Air medical escorts need to have a basic knowledge of aircraft and aircraft regulations to maximize their effectiveness. This knowledge helps experienced air medical escorts make appropriate decisions for each individual patient transport and provide the best care. Physicians who understand these principles will choose the most appropriate aircraft or air medical service for a given flight.

Learning Objectives

Upon completion of this chapter, the participant should be able to:

- ▶ Name two Federal Air Regulations that relate to air medical services.
- ▶ Define statute mile, nautical mile and knot.
- ▶ State one condition that should not be a factor in a pilot's decision about whether or not the weather is safe for flying.
- ▶ List the five basic parts found in all aircraft and describe their function.
- ▶ List three effects a non-pressurized cabin can have during an air flight.
- ▶ List two advantages to cabin pressurization.
- ▶ List at least five actions to avoid taking when near aircraft.
- ▶ List five rules to follow when working around helicopters.

General Aviation Considerations—Valid for All Aircraft Types

Regulations

The Federal Aviation Administration (FAA) is the government agency that regulates air operations in the United States. Part 91 and Part 135 of the Aeronautical Information Manual/Federal Aviation Regulations (AIM/FAR) contain most of the regulations that affect air medical transports in Alaska. The operating rules in the AIM/FAR¹ govern issues (e.g. acceptable weather minimums; required aircraft equipment; flight crew restrictions, including crew duty hours). Different sections of the FAA regulation apply to different types of aircraft operators; these include Parts 91, 135 and 121.

Part 91: General Operating and Flight Rules

This section of AIM/FAR covers private planes and public aircraft.

“Public aircraft” is defined as aircraft used only by a government.

“Government” includes the national government, state governments and political subdivisions of those governments.

- Carriers flying under Part 91 have fewer restrictions than those flying under Part 135. For example, the North Slope Borough Medevac Service and Critical Care Air Ambulance operate under Part 91.
- Carriers generally governed by Part 135 may fly under Part 91 regulations when they are flying without patients, and to reposition their aircraft. When these organizations are flying under Part 91, only people who have been specifically trained by the air carrier/s as crewmembers may be on board. This training includes, but is not limited to, the operation of emergency exits, the operation of fire extinguishers, passenger briefing, the operation of emergency locator beacons, and emergency use of oxygen. Examples of a Part 135 carrier being able to operate under Part 91 are listed below:
 - Returning an aircraft to its base of operations after an air ambulance mission has been completed; or

¹C. E. Spence, (ed.), *AIM/FAR 2001 Aeronautical Information Manual/Federal Aviation Regulations*, McGraw-Hill, San Francisco, 2001, pp. 614–712.

- If a company is moving an aircraft to a location to replace another aircraft that is down for prolonged maintenance.

Part 135: Commuter and On-Demand Operations

This set of regulations covers smaller commuter and charter air operations. In particular, it applies when an operator charges for flights or is a commercial operation. Most air ambulances in Alaska operate under this section of the FAA regulations. Part 135 Subpart A defines which services and aircraft types can be operated under these rules.

Part 135 Subpart F regulates crewmember flight time, duty period limitations, and rest requirements. An air medical escort should be familiar with the following restrictions:

- Pilots have restrictions on the number of hours they can be at work and fly. Pilots may not be able to accept certain flights if the flight would cause them to exceed the allowable hours.
- These specific limitations are described in Part 135.267 Flight Time Limitations and Rest Requirements: unscheduled one and two pilot crews, and in Part 135.271 Helicopter Hospital Emergency Medical Evacuation Services (HEMES) in the AIM/FAR.
- Pilots failing to follow these regulations risk losing their pilot licenses.

Part 121 is the most stringent set of flight regulations. Alaska Airlines and the other large airlines operate under this section.

Factors Influencing Air Medical Decisions

Distance and Speed

Aviation measurements vary from those used when traveling on land. Aircraft speeds and distances are measured in knots and nautical miles.

- A statute (land) mile is equal to 5,280 feet.
- A nautical mile is 6,076 feet.
- A knot is a unit of speed equal to one nautical mile per hour.

An easy way to approximate an aircraft's speed in miles per hour (mph) is to multiply the air speed (expressed in knots) by 15%, and then add this number to the airspeed in knots. This gives speed in mph. For example, an aircraft cruising at 100 knots is traveling at 115 mph (100 knots x .15 = 15; 100 + 15 = 115).

Aircraft with turboprop or jet engines are generally able to fly higher and faster than helicopters and piston engine planes.

Weather

Weather plays an important role in a pilot's decision to accept or reject an air medical transport request.

- The pilot must be aware of the weather at the point of origin, at the destination and at the points in-between.
- The pilot should know ONLY the destination of the flight and possible altitude restrictions when a flight is requested.
- The patient's condition should NOT be a factor in the pilot's decision about whether a flight is safe.
- Other factors that can create hazards to flight include:
 - Thunderstorms.
 - Turbulence.
 - Wind (including wind shear).
 - Icing conditions.
 - Snow.
 - Fog.
 - Smog.
 - Smoke.
 - Haze.
 - Volcanic ash.

Pilots can get weather information in several different ways:

- If there is a control tower or flight service station in the community to which the pilot is flying, the pilot can request current and forecasted weather information. Most small to intermediate airports in Alaska do not have control towers to provide up-to-the-minute information.
- Pilots may have to rely on automated weather stations. According to the Federal Aviation Administration (FAA) there are 96 sites in Alaska with automated weather monitoring systems that a pilot can access remotely by phone or Internet. The Automated Weather Observing System (AWOS) and Automated Surface Observing System (ASOS) both serve Alaska.
- Occasionally, in very remote locations, a pilot may need to contact a trained weather observer.

Visibility

Visibility is also a factor in safe aircraft operation. Visibility is described as the distance that one can see, usually reported in miles, and ceiling, which is the distance between the ground and the bottom of the lowest cloud layer (e.g. example, weather might be reported as 2 miles with a ceiling of 1,000 feet). Factors that can affect visibility include:

- Fog.
- Haze.
- Smoke.
- Rain.
- Snow.
- The presence or absence of operating runway lights. Many smaller airports in Alaska do not have runway lights. Starting in 2002, communities without runway lighting might qualify for a program of portable runway lighting. Vandalism may also routinely result in damaged lights at some airports.

- Night operations. Some pilots or air carriers do not fly after “civil twilight.” FAA regulations define “civil twilight” in Alaska as the time when the sun is 6° or more below the horizon. The actual time of “civil twilight” varies daily depending on latitude and longitude.

The terms Visual Flight Rules (VFR), Special Visual Flight Rules (Special VFR), and Instrument Flight Rules (IFR) are different sets of flying rules based on visibility conditions.

- VFR/IFR operating limitations for Part 135 are listed in Subpart D (135.201).
- An aircraft flying on “instruments” (IFR conditions) still needs adequate visibility to land.
- Most air medical aircraft are equipped with “instruments” to ensure IFR capabilities.

Navigation

There are a series of routes (highways) in the sky on which aircraft fly. They usually are along directional radio beams. Aircraft flying in different directions are assigned to fly at different altitudes.

Most of the larger planes used for air medical transports are equipped with Global Position Systems (GPS). GPS uses satellites to locate the GPS unit’s position. The onboard navigation computer then interprets this information, and the pilot can determine the location of the aircraft. Coordinates of airfields and waypoints along the route are stored in the navigational computer. These aircraft computers can:

- Determine the exact location of the aircraft, and the direction, distance, and time to the next waypoint.
- Provide information about the direction and distance to the closest airport in case of an emergency.
- Provide information about airports.

The FAA is currently implementing a new system called CAPSTONE. Phase I of this system is in the Bethel area and phase II is in Southeast Alaska. The CAPSTONE equipment is installed on aircraft and can give the pilot:

- GPS information.
- Terrain data.
- Communications with other aircraft equipped with CAPSTONE.
- Weather data.
- Information about approaches to airports.
- Information about air traffic.

The FAA in the Bethel area has equipped almost 200 aircraft with the CAPSTONE system. The Phase II program began in 2002, and is moving forward in Southeast Alaska. More information about the CAPSTONE program and technology can be found at: www.alaska.faa.gov/capstone.

Weight and Balance

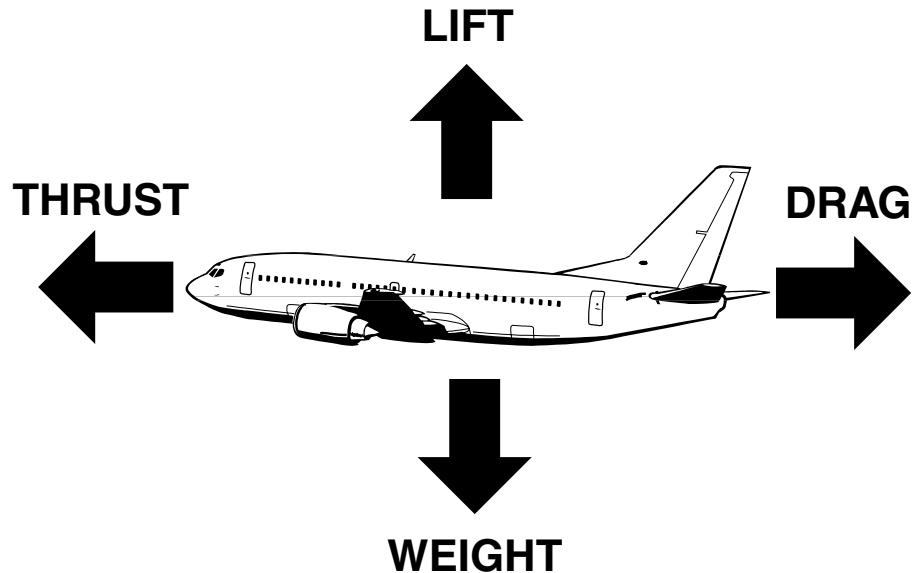
Aircraft are designed to carry a specified maximum weight.

When planning for a specific flight, the pilot must factor in the weights of the variables listed below, and ensure that the total stays below the maximum weight allowed for a specific aircraft. These variables include:

- The empty aircraft.
- All permanently installed equipment.
- The survival and medical equipment.
- The fuel for a given flight.
- Any baggage for the crew, patient and non-medical escorts.
- The people on board the aircraft (pilots, medical escorts, non-medical escorts and the patient).

The overall weight of the aircraft and its contents are important factors in medevacs. Equally important is the distribution of that weight in the aircraft. The picture below shows the four forces acting on an airplane.

The aircraft has a center of gravity, which is a “theoretical point where the entire weight of the aircraft is considered to be concentrated.”² To sustain level flight, the lift of the aircraft must offset the weight of the



aircraft plus the tail-down forces that come from air moving across the horizontal surfaces on the tail. In aviation, the term “stall” is when a surface (usually a wing) loses lift. When this happens, gravity becomes the dominant force and the plane begins to fall out of the sky.

- If weight is too far forward, the aircraft requires more distance for take-off and is prone to stalling at higher speeds.
- If weight is too far back (aft) in an aircraft, the aircraft becomes very unstable. It may be difficult or impossible to recover from a stall or spin.

Air medical crews must consult with the pilot about the appropriate placement of the patient, crewmembers, medical gear and baggage. In smaller aircraft, even a person moving quickly forward and aft can disturb the center of gravity.

²Jeppesen, *Private Pilot Manual*, 13th edition, Sanderson Training Products, Englewood, 1995, pp. 1–25.

Maintenance

There are two types of maintenance: scheduled and unscheduled. The FAA requires scheduled maintenance because failure of a mechanical part in an aircraft can be deadly. Certain parts must be replaced and other parts must be taken apart and inspected on a regular basis. Scheduled maintenance is based on:

- The number of hours of operation (e.g. every 300 hours).
- Time (e.g. every 12 months or a 12-year airframe inspection).
- The number of times the engine has been started (e.g. every 600 starts).
- The number of landings (e.g. inspections after every 3000 landings).

Unscheduled maintenance occurs if an aircraft part breaks or the pilot or medical crew notes an irregularity. Maintenance personnel must inspect the affected system/s and make any necessary repairs. Inspections also must be performed if an aircraft has experienced any of the following situations:

- A hard landing
- An overweight landing
- Severe turbulence
- A high energy stop
- A landing gear extension at high speed
- A lightning strike
- High ground wind gusts
- Deployment of a drag chute. A drag chute is a device found in some planes that can be used to help slow an aircraft—they are not used in normal landings.

Aircraft failing this type of inspection need to be repaired before they can be used for medical missions.

Time

In order to reduce the confusion that can occur because aircraft can fly across time zones, aviation uses a 24-hour clock system. The international standard adopted in aviation is called Coordinated Universal Time (UTC) or Zulu time. UTC is the time at 0° longitude that passes through Greenwich, England (GMT).

Add nine hours to Alaska Time to calculate UTC or Zulu time. (For daylight savings time, subtract one hour after converting to UTC.) Using UTC and the 24 hour clock:

- When it is six o'clock in the morning in Alaska (standard time), it is 1500 Zulu time.
- When it is six o'clock in the evening in Alaska (standard time), it is 0300 Zulu time the next day.
- During daylight saving time it will be 1400 Zulu time instead of 1500 and 0200 Zulu time instead of 0300.

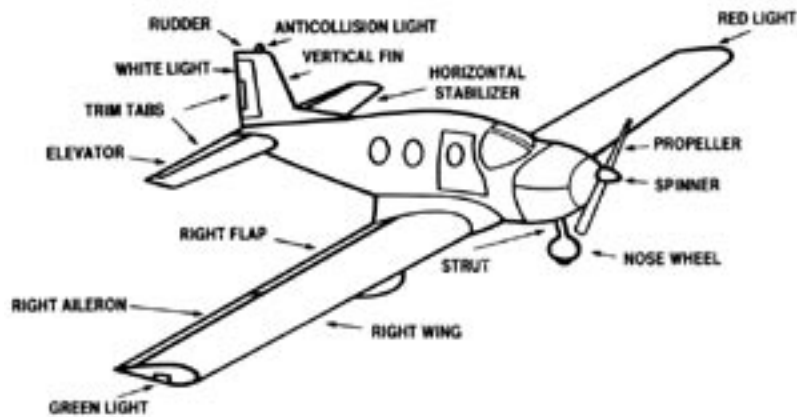
Characteristics and Types of Aircraft

Aircraft are broadly classified as either fixed wing aircraft (airplanes) or rotor wing aircraft (helicopters). All aircraft consist of five basic parts—the wing, the power plant, the tail assembly (empennage), the landing gear, and the fuselage (body). The design features of various aircraft determine their flight characteristics and abilities. These include speed, cruising range, and the length of landing field required.

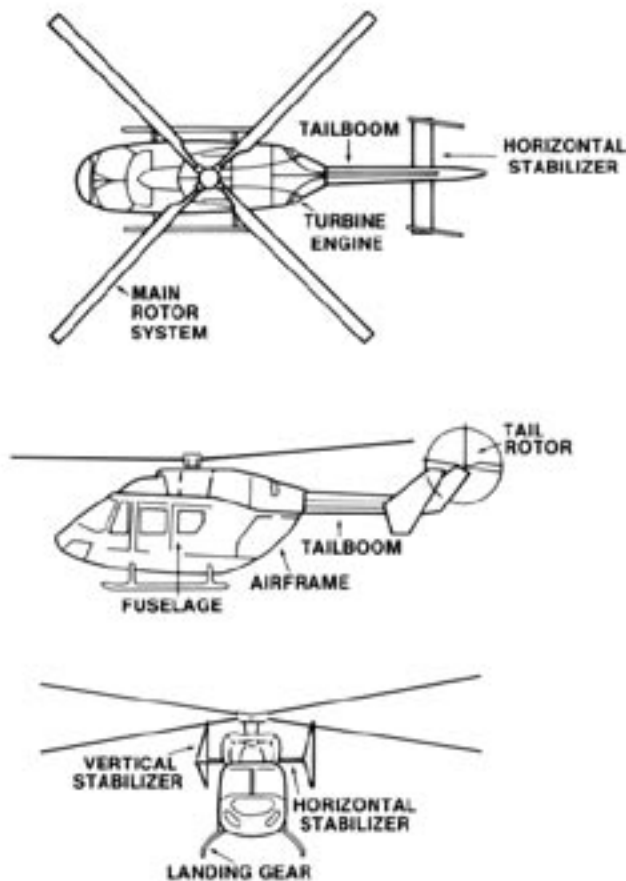
The diagrams on the next page label parts of each type of aircraft.³

³*Air Medical Crew National Standard Curriculum*, U.S. Department of Transportation, National Highway Traffic Safety Administration, 1988.

Fixed Wing Aircraft



Rotor Wing Aircraft



The Five Basic Parts of an Aircraft

Wings

The wings provide lift for the aircraft during flight. In some fixed wing aircraft they also may be used for fuel storage, as a place to mount engines, or even as a place to store items which will not be needed during flight (e.g. in wing lockers).

- They may be attached at the top, middle, or lower portion of the fuselage. The Cessna Caravan is a high wing airplane, while the Beechcraft King Air and the Piper Navajo are low wing airplanes.
- Their placement can affect the length of runway required for takeoff and landing.
- Wing placement can affect how the aircraft is loaded and unloaded.

The front part of the wing is referred to as the “leading edge.” The rear of the wing is called the “trailing edge.” Two flight control surfaces, flaps and ailerons, can be found on the trailing edge of wings.

Ailerons

- Are found on the outboard (farthest from the fuselage) end of the wings.
- Move in opposite directions. When the pilot turns the control yoke, one aileron will move upward while the other will move downward. This causes the aircraft to “roll,” or turn.

Flaps

- Are inboard (closer to the fuselage) from the ailerons.
- Move in unison.
- Retract into the wing in some aircraft during normal flight.
- Are used when the aircraft needs more lift, such as during take-off, landing, and when the aircraft is flying at slower speeds. Flaps are extended to varying degrees of downward position.

Fuselage

The fuselage is the body or cabin of the aircraft. It is divided into the flight deck and cabin. The flight deck is the forward portion of the fuselage or cockpit. The cabin is the passenger compartment.

Smaller aircraft may have little or no dividers separating the flight deck from the cabin, while in larger aircraft there can be significant barriers between the two areas. If the flight deck is open to the cabin, it is important that the medical flight crew be careful not to interfere with the pilot's operation of the aircraft.

Tail (Empennage)

The rear portion of the fuselage is known as the tail section or empennage. This area contains the vertical fin and horizontal stabilizer.

- The vertical fin contains the rudder, which is used to steer the aircraft (along with the ailerons).
- The horizontal stabilizer contains the elevators. These are small flaps on the rear surface on each side of the tail. They work together to raise or lower the nose of the aircraft.
- Other empennage designs (e.g. Lear 31A) use a stabilator with antiservo tabs rather than the more common elevator/horizontal stabilizer design.

These components of the empennage are vital to the control of the aircraft.

Landing Gear

There are many types of landing gear found on aircraft used for air medical transport. Planes may be equipped with wheels, floats, combination wheels and floats, or skis.

Wheeled Aircraft

- Have a wheel or wheels under each wing and a third wheel either at the nose or at the tail.
 - When the third wheel is in the rear of the aircraft it is called a conventional landing gear or a "tail dragger." These are common on bush planes because it provides additional engine clearance, especially on gravel landing strips.
 - When the third wheel is in the front of the aircraft, it is called a tricycle gear. This design is common on larger aircraft.

- May have multiple wheels in each location on larger aircraft.
- Can have non-retractable (fixed) wheels or retractable wheels. Retractable wheels fold into the fuselage to provide less resistance to flight.

Floats and Skis

- Are the only means of access in some areas of the state.
- Can be used by different sized planes. The size ranges from smaller aircraft like a Cessna 172 to the larger Grumman Goose.

Sometimes smaller float planes are used to take patients to a larger airport for transfer to an aircraft capable of flying higher and faster.

Combination aircraft have floats with wheels and allow planes to take-off and land on either land or water. The plane can leave from a runway, pick up a patient on water and fly to another runway.

Power Plant

The power plant of the aircraft is made up of the engine and associated structures like the propeller, which provides forward motion for the plane. There are three types of aircraft engines.

Piston Engine

- Turns a propeller.
- Burns aviation gas (av-gas).
- Is usually found on smaller aircraft like the Cessna 172 or the Piper Navajo.
- Generally are not found in pressurized aircraft.

When working around piston engine aircraft the propeller must not be touched, even if the aircraft is turned off. If a particular switch has been left in the “on” position, moving the propeller may cause it to spin suddenly or start the engine.

Turboprop or propjet

- Is a small jet engine that turns a propeller.
- Burns jet fuel (Jet-A or Jet-B).

- Usually has an air intake at the front of the engine and a metal exhaust pipe leading from the side or the rear of the engine.
- May or may not be found in aircraft with a pressurized cabin.
- Commonly used turboprops for air medical transport include the Cessna Caravan (208), the Beechcraft King Air, and the Swearingen Merlin.

Crew members must be aware of the heat of the exhaust pipe and gasses when working around this type of aircraft.

“Pure” jet engine

- Burns jet fuel.
- Is much faster than either piston engines or turbo props.
- Usually requires a longer runway than other types due to speed.
- Is prone to damage if operated on unpaved landing strips without approved modifications to the aircraft. Very few air medical providers will take a jet aircraft into a location with a gravel landing strip.
- Are found in aircraft with pressurized cabins.
- Is able to travel at much higher altitudes.

Aircraft can have one, two, three or four engines. Most air medical aircraft in Alaska are single or twin-engine models.

Helicopters

Helicopters (rotor-wing aircraft) are usually slower than fixed-wing aircraft. They require a smaller area for take-off and landing. ***This does not mean that helicopters can fly in all weather and land in any conditions.***

As an air medical transport vehicle, helicopters have grown in popularity over the last few years because of their rapid response time to areas otherwise difficult to reach. Alaska’s vast distances, however, limit the use of rotary aircraft. Helicopters tend to have shorter ranges than fixed-wing aircraft (often 200–300 miles). A notable exception to this range limitation is the Alaska Air National Guard’s “Pavehawk”

helicopter with in-flight re-fueling capability. The Blackhawk (US Army) and Jayhawk (US Coast Guard) share the same airframe as the Pavehawk, but they are not usually able to perform in-flight refueling. Other differences between the Blackhawk, Pavehawk and Jayhawk are specific to the requirements of their particular branches of the military.

The unique safety concerns and equipment features found in helicopters require special orientation and training for those who will work around them.

Cabin Pressurization

Cabin pressurization keeps the air pressure inside the aircraft's cabin higher than the air pressure outside the aircraft. The higher the plane flies, the lower the outside air pressure. If the aircraft is flying at an altitude of 34,000 feet, the air pressure outside will be approximately $\frac{1}{4}$ that found at sea level. The term "cabin pressure" is used to describe the altitude that is experienced by people inside the aircraft. An Alaska Airlines jet may be flying at 31,000 feet, but the cabin is pressurized to the same air pressure found at 7,000–8,000 feet.

The following factors should be considered when choosing between a pressurized and unpressurized aircraft:

Pressurization

- Reduces the effects of altitude on the human body (e.g., pressurization will help in treatment for hypoxic patients).
- Makes flights more comfortable.
- Allows planes to fly above most weather and over most obstacles (e.g. mountains).

Pressurization capabilities differ among aircraft. Helicopters and piston engine aircraft typically are not pressurized. Turboprop aircraft may or may not be pressurized (the Cessna Caravan is a non-pressurized turboprop, while the Beechcraft King Air is pressurized). Jet aircraft are generally pressurized.

Pressurized aircraft are quieter and fly faster, but may require longer runways. They also cost much more to purchase or lease than unpressurized aircraft.

Unpressurized Aircraft

- Are often noisier, colder, and have a higher likelihood of route restrictions due to weather and/or terrain.
- Require closer monitoring of patient's oxygen status.
- May require pilots, flight crewmembers, patients, and non-medical escorts to use supplemental oxygen if they fly above certain altitudes. The requirements governing this are specified in the FARs.
- Cost less than pressurized aircraft.

A healthy non-injured person generally can tolerate altitudes up to 10,000 feet. A patient with hypoxia may deteriorate after very small altitude changes. Discussions of altitude, the gas laws, hypoxia and oxygenation will be covered in Chapter 3 and Chapter 4 of this manual.

It is interesting to note that Denali (Mt. McKinley) is 20,320 feet (6,193 m) and Mt. Everest is 29,035 feet (8,856 m). People can and do climb to these altitudes, but it is only after careful acclimatization, and in the case of climbing Mt. Everest, often with the use of supplemental oxygen.

Aircraft Selection

Variables to Consider

The following examples illustrate several of the variables to consider when selecting an aircraft.

A typical commercial jet airliner, like a Boeing 737

- Seats between 21 and 189 depending on its use and the airline.
- Has a typical cruise speed of 530 mph.
- Has a cruising altitude of 31,000 to 39,000 feet while maintaining a cabin altitude of approximately 7,000 feet.
- Has a range of approximately 2,300 to 3,000 miles.

A Lear Model 35 is a twin-engine low-wing jet

- Seats eight.
- Has a 2,000-mile cruising range at about 500 mph.
- Can maintain sea level cabin pressure up to 24,000 feet, and will pressurize to 8,000 feet while cruising at 45,000 feet.
- Requires a 5,000-foot paved or improved runway.

A Navajo Chieftain (Piper PA-31-350) is an unpressurized, low wing, twin propeller aircraft

- Seats eight.
- Has a cruising speed of 180 knots (207 mph).
- Has a range of 800 miles.
- Requires about 1,800 feet of runway.

It is important to consider how long a patient may spend in transit between facilities. It may be quicker to place a patient on a non-pressurized plane that is sitting on the runway in a village, rather than wait for an air ambulance from a regional center or urban area. However, it may be better for the patient to stay at the clinic or hospital until a more suitable plane can be brought to the patient. The patient in the first case may have a two-hour flight in the unpressurized plane, while the patient held at the clinic may only need to spend 45 minutes in the faster plane.

Patients' Needs

In many Alaskan communities there may be only one aircraft available for air medical transport. When it is possible to consider alternatives, several criteria merit review.

1. The patient's condition

Air ambulance flights are used to transport patients. Providing the best aircraft for the patient's medical needs is the most important consideration.

The following characteristics are often considered when selecting between aircraft:

- Pressurization.
- Noise levels.
- How the aircraft handles turbulence.
- Vibration. (e.g. helicopters with four-blade rotor systems are generally smoother than those with two- or three-blade rotor systems).
- Speed.
- Internal cabin size (and thus working area).
- Availability of electrical power for medical equipment.
- Patterns of ascent and descent (e.g. speed, angle required, etc.).

The best choice for a patient will depend on his or her medical condition at the time of the flight. The person choosing the air ambulance service or aircraft should try to match aircraft features with the patient's most pressing medical need/s.

An example of how a patient scenario may influence the type of aircraft that is chosen for a medical mission is given below.

A 26-year old male patient with an open head injury requires transportation to a facility with a neurosurgeon. Characteristics important when transporting patients with head injuries include pressurization and the patterns of ascent and descent.

- If the patient is being transported from Kenai to Anchorage there is not enough distance for a jet or turboprop aircraft to climb to cruising altitude. Therefore, most aircraft would be appropriate to use for this flight.
- If the patient is being transported from McGrath to Anchorage, the aircraft must cross 10,000-foot mountains. In this situation an aircraft with cabin pressurization likely would be more appropriate.

In both situations, a plane with relatively slow take-off and landing speeds will minimize the effects of acceleration and deceleration. If transport speed is of utmost concern, though, as is often the case in remote transport, a faster, pressurized aircraft may be more appropriate.

With an understanding of the principles of flight physiology, air medical personnel will have little trouble in selecting the best aircraft for specific medical flights.

2. Landing capability, conditions, and location

The process of selecting the best aircraft for a given flight may involve factors beyond the patient's medical status. The patient's location can play a role in selecting an aircraft in many Alaska medevac situations. Geography and the nature of the landing area often limit choices to small fixed-wing aircraft or helicopters.

Many communities with their own hospitals also have access to commercial jet service. They have the option of transporting patients on scheduled commercial flights. This is becoming much less common because of:

- Airline concerns about communicable diseases.
- Increased availability of air medical transport aircraft with specialized crews and equipment.
- Increased security concerns after September 11th, 2001. It may be impossible to bring certain pieces of medical gear, particularly sharp objects like needles and scalpels, on board commercial aircraft.
- Safety concerns. For example, transporting oxygen cylinders on commercial aircraft, unless certified empty, is prohibited by the FAA unless prior arrangement with the airline has been made to have the airline supply medical oxygen.

3. Cost

If the patient's condition will not suffer, the cost of the carrier can be considered. Dedicated air medical services generally cost much more than commercial airline flights. However, on larger commercial aircraft (like a Boeing 737 or MD80), transporting a stretcher patient requires nine tickets (three rows of three seats each). Last minute ticket purchases are expensive.

4. Physical characteristics of the aircraft

Patients can find being loaded or off-loaded from an aircraft to be uncomfortable. Consider the following features of aircraft cargo or access door/s when choosing a plane for air medical missions:

- Location on the plane
- Dimensions
- Method of opening
- Relationship to the center of gravity
- Presence or absence of steps
- Distance from the ground

Successful avoidance of both lengthwise and lateral tipping of the patient also depends on interior fuselage dimensions and the length of the stretcher or litter being used. On commercial aircraft, specialty equipment (e.g. food service truck, fork lift, or belt loader) may be used to load and unload patients.

Communications

There are three basic types of communications used onboard aircraft:

1. Radios

VHF (AM) radio (118–136MHz)

- Used for most communications from an aircraft.
- Used by pilots to talk with the Control Tower, a Flight Service Center, or Air Traffic Control either by line-of-sight or through repeaters.
- May be able to be accessed by hospitals and clinics with a base radio, but the range may be limited.

Marine VHF (FM)

- Used by some aircraft, usually along the coastline.
- Can be a built-in radio or a handheld model.

- Generally has a short range.
- The emergency channel on this type of radio is Channel 16.

Single Side Band

- Operates on high frequency (HF).
- Used on some aircraft.
- Long-range radio.

Local EMS radios are not compatible with aircraft radios. They normally operate in the 150 MHz range or on an 800 MHz or 900 MHz trunked system.

Military aircraft usually have both UHF and VHF (FM). Some may have additional radios.

2. Telephones

Mobile phones:

- Use of cellular phones while flying is prohibited.
- Can be useful at the scene of a rescue, a clinic or a hospital.
- Cell phones have limited line of sight working range to a repeater station. They, therefore will not function in many remote areas of Alaska and in some mountainous terrain.
- Many cellular phone service providers allow the user to dial *CG to contact the US Coast Guard quickly.

Satellite phones:

- Are becoming more common.
- Need a line of sight to a satellite, which may be low on the horizon or obstructed by parts of the aircraft.
- Work better with an external antenna built into the airframe. External antenna for satellite phones can be expensive.
- Installation of satellite phones in aircraft must be approved by the FAA and tested to ensure that there is no interference with the operation of the aircraft's navigation and electrical systems.

3. Emergency Locator Transmitters (ELTs)

- Provide one-way communication in an emergency from the aircraft to potential rescuers.
- Transmit to satellites on frequencies of 121.5/243.0 or 406MHz.
- Begin transmitting when internal sensors detect impact.
- ELTs using 406 MHz are becoming more common. They carry an identifier code for the aircraft, are more accurate and result in a faster response time for rescuers.
- The FAA strongly recommends that operators switch to 406 MHz ELTs.

In 2009 121.5/243.0 MHz will no longer function as a satellite monitoring frequency. However, the 406 frequency ELTs still will have a low power 121.5/243 signal for the use of local SAR radio direction finding equipment.

Radio and telephone communications have limitations and present challenges to medevac responders. The following are some of the problems faced by responders in planning and communicating during medevacs:

- Short operating ranges.
- Operation only along line-of-sight.
- Lack of an interface between radio systems.
- Lack of consistent access to repeaters and/or cellular sites across the state.

Radio Reception:

Radio reception can be poor. It may be necessary to “spell” out a word. To do this, a phonetic alphabet is used. Each letter has a word assigned to it that is easier to understand than the sound of the letter. This alphabet also is used when specifying an aircraft tail number.

Lifeguard:

Under FAA regulations, any aircraft is designated “Lifeguard” when it:

- Is en route to pick up a patient.

Phonetic Alphabet for Radio

A	Alpha	N	November
B	Bravo	O	Oscar
C	Charlie	P	Papa
D	Delta	Q	Quebec
E	Echo	R	Romeo
F	Foxtrot	S	Sierra
G	Golf	T	Tango
H	Hotel	U	Uniform
I	Indigo	V	Victor
J	Juliet	W	Whiskey
K	Kilo	X	X-ray
L	Lima	Y	Yankee
M	Mike	Z	Zulu

- Has a patient onboard.
- Has a declared medical emergency onboard.

The “Lifeguard” designation should not be confused with Providence Alaska Medical Center’s air medical service out of Anchorage, which uses the name LifeGuard Alaska. The Lifeguard designation gives a medical aircraft priority over most other aircraft in take-off and landing sequencing. The exception to this rule would be an aircraft experiencing an in-flight emergency.

Aircraft Identification:

During a radio transmission, aircraft are identified by:

- Type of aircraft.
- The Lifeguard designation when appropriate.
- Tail number. The tail number of any aircraft registered in the United States starts with the letter “N” and is followed by numbers. It may end in more letters.

When the aircraft is involved in an air medical flight, “Lifeguard” is spoken at the beginning of the number. For example, if the tail number of a Beechcraft King Air were N43CE, the radio operator would identify the aircraft as “Lifeguard, King Air, 43-Charlie Echo” while on a medical flight.

Radio Communications Techniques

The United States Department of Transportation (US DOT) Guidelines for Air-Medical Crew Education (1988, 2001) recommend the following techniques for improved radio communications. Radio operators should:

- Speak at a normal volume and in a normal tone of voice.
- Speak clearly, but do not over-enunciate.
- Be clear and avoid the use of ambiguous pronouns. For example, the operator should not say, “He’s signaling there are wires to his left.”
- Prepare what they will say before beginning to speak.
- Be succinct.

- Limit their radio use to required transmissions only.
- Hold the microphone control down for an extra second before beginning transmissions, if the system uses repeaters.
- Avoid the use of “10-codes.”
- Maintain confidentiality by not giving the patient’s name over the radio.
- Give the other party’s identifier first and then give their own.
- Be aware that others may be listening to their transmissions.
- Be professional at all times.

Safety

Orientation

All air medical escorts should have some general knowledge of the aircraft in which they are traveling. This information should include the location and operation of:

- Seat belts or harnesses.
- Emergency exits.
- Survival gear.
- Emergency locator transmitter (ELT).
- Flotation equipment.
- Fire extinguishers.

Check for Hazards and/or Weapons

The crew needs to ensure that hazardous materials are not brought onboard a medical aircraft. This may include performing a weapons check of patients and their escorts. The flight or medical crew can perform this check before passengers are permitted onboard the aircraft.

Cancellation of Flights

Agency policy will dictate who has the authority for canceling missions. In some agencies, any member of the crew can refuse a flight if they are uncomfortable with the weather, etc. For other agencies, the Pilot in Command is the person who will decide to cancel or continue a flight. The Pilot in Command is the final authority for deciding if a medical request for a low (cabin) altitude will be honored.

Airstrip/Airport Safety

Aircraft carry their own specific hazards that can affect safety at airports and airstrips. Escorts should:

- Not aim vehicle lights at an aircraft that is landing.
- Not smoke within 50 feet of the aircraft.
- Not run within 50 feet of the aircraft.
- Be sure everything within 50 feet of the aircraft, including articles on the stretcher, is secure and cannot become loose, unless all aircraft engines are shut down.
- Not drive any vehicle (e.g. ambulance) within 30 feet of the aircraft or the vehicle exclusion zone without guidance from the flight crew.
- Follow proper procedures during refueling. A fire extinguisher must be available and passengers are not permitted to remain on the aircraft. An exception to this rule is made when a patient and a medical escort must remain on the aircraft during refueling.
- Be aware of high exhaust temperatures and jet-blast exhaust, fumes, and noise around turbine-powered aircraft.
- Stay clear of the propeller operating area, even when engines are shut down.
- Not lay equipment or supplies on the wings, as this could damage wings.
- Never open the door or disembark from the aircraft without approval from the pilot.

Securing Equipment and Personnel

All equipment must be secured for flight. FAA regulations assign this responsibility to pilots. Therefore, equipment storage should be under the supervision of the pilot. Cargo straps, cargo nets, seat belts or harnesses, or other tie-down methods should be used to secure equipment. It is recommended that all equipment remain secured for the entire flight.

All personnel must be secured for take-off and landing in compliance with FAA regulations. They include:

- A recommendation that seat belts or harnesses be used during the entire flight as unexpected turbulence can occur at any time.
- Certification of patient restraint devices for particular aircraft. A LifePort PLUS® module or the Spectrum Aeromed® stretcher system cannot be installed in an aircraft unless it has been certified for use in that type of aircraft. If the patient is on a stretcher, it is essential to check that the patient is secured to the stretcher and that the stretcher is secured to the aircraft.

The Pilot in Command should be familiar with what the FAA permits and what it does not permit.

Take-Off and Landing

Talking with the pilot during landing or take-off is against FAA regulations. In pressurized aircraft the cockpit is designated as “sterile” below 10,000 feet and no one is allowed to interrupt or bother the pilot.

Artificial Lighting

Artificial lighting should not be used during take-off or landing. This is very important in an aircraft that does not have a divider between the cockpit and the patient compartment.

Pilots determine whether or not a flashlight is permissible during flight, and what color light can be used. Red or amber lights will help preserve pilots’ night vision. A very dim green light may be permitted if the crew is wearing night vision goggles. Air medical escorts should check with pilots about permissible lighting before aircraft take off. Unexpected increases in cabin light can temporarily blind pilots, especially if they are using night vision goggles.

Escorts should never move any cockpit control or switch without direct guidance from pilots. Pilots have no way of knowing that escorts are not going to touch something vital. Before acting in the cockpit, escorts should always ask permission.

Portable Emergency Airport Lighting

Nighttime and low-visibility air medical operations to rural communities that lack runway lighting can be difficult and dangerous, placing both the patient and air crew at risk. Beginning in 2002, federal appropriations to provide lighting to rural airstrips in Alaska enabled the FAA and the State to improve the airport lighting infrastructure. Airports that have no airport lights, and where conventional lights cannot be installed, are receiving portable lights. The portable light is a rechargeable, battery-powered, cold cathode lamp, similar to neon lighting. It produces a diffuse light source that is compatible with night vision goggles and does not induce spatial disorientation in the pilot, which is a known cause of accidents and fatalities.

The portable lights are certified by the FAA and in use by the military throughout the world. Where suitable, communities will receive enough portable lights to outline a 3,000-foot runway. Where conditions are not suitable for nighttime fixed-wing operations, six lights will be available to set up a rotor-wing landing zone. Contact the local clinic or emergency medical service to determine whether the community has a set of the portable runway lights or portable landing zone lights.

In-Flight Emergencies

Information about what to do during an in-flight emergency is covered in Chapter 10.

Helicopter Specific Information

Highlights

Helicopters present their own unique safety hazards. The following information highlights the most important ones:

- No one should be allowed on the helipad or within 50 feet of the helicopter when the blades are in motion, unless directed by the pilot or flight engineer. People can approach only when waved in by the pilot. In a helicopter, the Pilot-in-Command may sit on either the right or left side of the aircraft.
- The Pilot-in-Command is the final authority for the selection of a landing zone.
- All equipment must be secured. The loss of the smallest item, such as a rag or tie-down rope from the cabin or external cargo racks could mean the loss of a tail rotor, the aircraft, life or property. Stretchers should not have loose mattress pads, sheets, blankets, or any loose articles.
- Approach helicopters from the front.
- Stay low (duck) when approaching a helicopter. While the rotor blades may appear to have adequate ground clearance, a sudden wind can cause them to dip very close to the ground.
- When a helicopter is idling, the blade tips tend to sag closer to the ground. In order to approach the helicopter, the pilot may need to “spool up” the motor, causing more noise and flying debris. “Spooling up” increases the power to the rotor, gets the blades moving more quickly and so the blades fly a little higher off the ground.
- Unless the loading doors are located in the rear of the helicopter, NO ONE should be permitted near the tail. If the loading doors are located in the rear of the aircraft (e.g. Eurocopter BK 117), people should not operate near the doors unless a crew member is outside the aircraft to assist.
- Escorts must never hold IVs with up-stretched arms when blades are turning. If the stretcher has an attached IV pole, it should be minimally extended or removed from the stretcher.

- Do not approach or depart a helicopter from the uphill side if the helicopter is on a slope because the rotors will be closer to the ground on the uphill side.
- Everyone who is on a helipad to unload must receive helicopter safety instruction.
- Helicopter flight crew and those loading or unloading a helicopter that is running should wear eye protection (goggles), ear protection, and brightly colored clothing for visibility.
- Helicopters may sink into the snow due to the weight of the aircraft causing the blades to be lower to the ground than normal.
- During take-off, and especially during landing, there is a great deal of wind from the rotor blades (rotor wash). This may cause dirt, gravel, snow or other loose objects to swirl around. Anyone near the aircraft should have eye protection.
- It is generally acknowledged that it is safer to avoid “hot” loading and unloading. “Hot” loading and unloading is loading or unloading with the rotors turning. However, “cold” loading or unloading may not be possible in all situations.
 - Extreme cold can cause the helicopter’s battery to lose power and the aircraft may not restart if it is shut down.
 - If the helicopter lands on an unstable surface, like shale, the pilots needs to maintain power in case he or she needs to lift-off suddenly.

Helicopter Landing Zone Safety

The following guidelines will help escorts assist or set up a helicopter landing zone:

- Locate a 100 ft. x 100 ft. unobstructed, level landing area as close to the accident scene or location of the patient as possible.
- If appropriate, place flares at each corner of the landing zone during day and night landings.
- Direct auxiliary lighting, such as vehicle headlights, at the ground to avoid temporarily blinding the pilot.

- Never mark the landing zone with loose objects.
- Remove or secure all loose objects.
- Notify pilots of any ground obstacles about which they should be aware, like overhead wires, trees, poles, lights, signs, antennas or water towers.
- Keep all unauthorized people away from the landing area.
- Never use flashlights, strobes, or lights from cameras during landing or take-off operations.

Summary

Air medical escorts need not be aircraft experts in order to provide care in the air medical environment, but should must be familiar with the aircraft being used. Medical escorts should know basic information about any aircraft in which they fly patients. The table at right is a basic example of this. This information has been discussed in this chapter. If escorts are unable to answer these questions about the particular aircraft in which they are about to fly, they should talk with the pilot before the flight begins. The best time to do this is while planning for the air medical flights, not after a mission has been accepted.

Aircraft Information

Pressurized?

Door Dimensions:

Front Height

Rear Height

Center Height

Width

Passage Capability, not including flight crew

Range

Cabin Length and Height

Seat/Stretcher Configuration

Cruise Speed

Electrical Requirements;
Inverter Available?

Runway Length and Surface Required
(feet)

Medical Equipment Available

Payload

Notes
